Listing of the Claims

1. canceled

2. (currently amended) A gas-impermeable, mixed electron- and ion-conducting membrane consisting essentially of a porous electron-conducting matrix impregnated with a salt which is molten at membrane operating temperatures ~~The membrane of claim 1~~ which has a central region wherein the porosity is sufficiently fine to substantially retain molten salt in the pores therein, and external regions wherein the porosity is sufficiently greater than in the central region such that the pores in these regions are not substantially filled with molten salt.

3. (currently amended) The membrane of ~~claim 1~~ claim 2 wherein a sufficient amount of molten salt is impregnated into the electron-conducting matrix to facilitate ion transport through the membrane.

4. (currently amended) The membrane of ~~claim 1~~ claim 2 wherein the electron-conducting matrix is formed from the group of transition metals or mixtures thereof.

5. (original) The membrane of claim 4 wherein the metal is nickel or a mixture of nickel with another transition metal.

6. (currently amended) The mixed conducting membrane of ~~claim 1~~ claim 2 wherein the molten salt is a carbonate salt.

7. (currently amendedl) The mixed conducting membrane of ~~claim 1~~ claim 6 wherein the carbonate salt is a alkali metal carbonate, an alkaline earth metal carbonate or mixtures thereof.

8. (original) The mixed conducting membrane of claim 7 wherein the molten carbonate is a lithium carbonate, a potassium carbonate or mixtures thereof.

9. (currently amended) The membrane of ~~claim 1~~ claim 2 wherein the electron-conducting matrix is an electron-conducting ceramic.

10. (currently amended) The membrane of ~~claim 1~~ claim 2 which comprises a plurality of layers of different porosity.

11. (currently amended) The membrane of ~~claim1 which comprises~~ claim 2 wherein the external regions comprise a first and a second external region on either side of [a] the central region each external ~~surface~~ region having an inside surface in contact with the central region and an outside surface forming either a reducing surface or an oxidizing surface of the membrane ~~wherein the porosity of the central region is sufficiently fine to substantially retain molten salt in the pores therein, and wherein the porosity of the external regions is sufficiently greater than in the central region such that the pores in these regions are not substantially filled with molten salt~~.

12. (original) The membrane of claim 11 wherein the average pore size in the central region is less than 1 micron and wherein the average pore size in the external regions is greater than 1 micron.

13. (original) The membrane of claim 11 wherein the molten salt is a carbonate, halide, phosphate, sulfate or nitrate salt.

14. (original) The membrane of claim 11 wherein the oxidation surface of the membrane is provided with an adherent oxidation catalyst layer.

15. (original) The membrane of claim 14 wherein the adherent catalyst layer comprises a steam reforming catalyst.

16. (original) The membrane of claim 11 wherein the reduction surface of the membrane is provided with a reduction catalyst.

17. (currently amended) A membrane reactor comprising one or more gas-impermeable, mixed electron- and ion-conducting membranes of ~~claim 1~~ claim 2.

18. (currently amended) [A] The membrane reactor of claim 17 for the separation of carbon dioxide from a gas containing carbon dioxide in the presence of oxygen and the partial oxidation of a reactant gas wherein the external regions of the one or more gas-impermeable membranes comprise a first and a second external region on either side of the central region, each external region having an inside surface in contact with the central region and an outside surface forming either a reducing surface or an oxidizing surface of the membrane, and which further comprises:

~~one or more gas-impermeable membranes of claim 1;~~

a reduction zone in contact with [the] a reducing surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving a gas containing carbon dioxide and oxygen; and

an oxidation zone in contact with [the] an oxidation surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving a reactant gas[;] wherein the one or more gas-impermeable membranes separate ~~gas impermeable membrane separates~~ the reduction zone from the oxidation zone and wherein the one or more gas-impermeable membranes transport carbonate.

19. (original) The membrane reactor of claim 18 further comprising an oxidation catalyst in the oxidation zone of the reactor in proximity to the oxidation surface of the membrane.

20. (original) The membrane reactor of claim 19 further comprising a reduction catalyst in the reduction zone of the reactor in proximity to the oxidation surface of the membrane.

21. (original) The membrane reactor of claim 18 which comprises a plurality of gas-impermeable membranes.

22. (original) The membrane reactor of claim 18 wherein the gas containing carbon dioxide and oxygen is air.

23. (original) The membrane reactor of claim 18 wherein the reduced gas comprises methane, a lower hydrocarbon or naphtha.

24. (currently amended) The membrane reactor of claim 18 wherein the reactor further comprises a steam reforming catalyst in the oxidation zone of the reactor ~~and the reduced gas further comprises water~~.

25. (original) The membrane reactor of claim 24 wherein the steam reforming catalyst is nickel or a nickel-based alloy supported on alumina, titania, silica or zirconia.

26. (currently amended) The membrane reactor of ~~claim 23~~ claim 24 wherein the steam reforming catalyst is nickel supported on alumina.

27. (currently amended) The membrane reactor of claim 18 further comprising a three-dimensional catalyst in close proximity to ~~a membrane external~~ an oxidizing or a reducing surface of the one or more gas-impermeable membranes.

28. Canceled

29. Canceled

30. Canceled

31. Canceled

32. Canceled

33. (currently amended) [A] The membrane reactor of claim 17 for separating a reactive ion from a source gas wherein the external regions of the one or more gas-impermeable membranes comprise a first and a second external region on either side of the central region, each external region having an inside surface in contact with the central region and an outside surface forming first and second outside surfaces of each of the one or more gas-impermeable membranes, and which further comprises:

~~the gas impermeable mixed conducting membrane of claim 1 wherein the molten salt is selected for mediation of the reactive ion;~~

a reagent zone in contact with a first ~~external~~ outside surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving an ion source gas; and

a reaction zone in contact with a second ~~external~~ outside surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving a reactant gas;

wherein the one or more gas-impermeable membranes separate ~~gas impermeable membrane separates~~ the reagent zone from the reactant zone and wherein the one or more gas-impermeable membranes trnasport the reactive ion.

34. (original) The membrane reactor of claim 33 wherein the reagent zone is an oxidation zone and the reactant zone is a reduction zone.

35. (original) The membrane reactor of claim 33 wherein the reactive ion is a carbonate, a halide, a nitrate, a sulfate, a phosphate or an ammonium ion.

36. (original) The membrane reactor of claim 34 wherein a three-dimensional catalyst is provided in the oxidation zone, the reduction zone or both.

37. canceled

38. canceled

39. canceled

40. canceled

41. (currently amended)[A] The membrane reactor of claim 17 for separating an ionic species from a source gas wherein the external regions of the one or more gas-impermeable membranes comprise a first and a second external region on either side of the central region, each external region having an inside surface in contact with the central region and an outside surface forming first and second outside surfaces of each of the one or more gas-impermeable membranes, and which further comprises:

~~one or more gas impermeable membranes of claim1 which transports the ionic species to be separated;~~

a reagent zone in contact with a first outside surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving the gas from which the ionic species is formed and wherein the ionic species is formed; and

a reactant zone in contact with ~~the opposite~~ a second outside surface of the one or more gas-impermeable membranes ~~membrane~~ for receiving a gas into which the ionic species is transported and wherein the transported ionic species is released wherein the one or more gas-impermeable membranes transport the ionic species to be separated.

42. (previously presented) The membrane reactor of claim 41 wherein the one or more gas impermeable membranes transport an ionic species selected from the group consisting of carbonate, halide, phosphate, sulfate or nitrate ions.

43. (currently amended) The membrane reactor of claim 41 further comprising a three-dimensional catalyst in close proximity to ~~a surface of the membrane~~ an outside surface of the one or more gas-impermeable membranes.

44. canceled

45. canceled.

46. canceled.

47. canceled.

48. (new) A membrane reactor comprising one or more gas-impermeable, mixed electron- and ion-conducting membranes of claim 11.

49. (new) A membrane reactor comprising one gas-impermeable, mixed electron- and ion-conducting membrane of claim 11.

50. (new) A method for separating an ionic species from an ion source gas which comprises the steps of:

providing a membrane reactor of claim 17 wherein the external regions of the one or more gas-impermeable membranes comprise a first and a second external region on either side of the central region, each external region having an inside surface in contact with the central region and an outside surface forming first and second outside surfaces of the one or more gas-impermeable membranes, and which further comprises:

a reagent zone in contact with one of the first or second outside surfaces of the one or more gas-impermeable membranes for receiving a source gas;

a reaction zone in contact with the other of the first or second outside surfaces of the one or more gas-impermeable membranes oxidation surface wherein the one or more gas-impermeable membranes separate the reagent zone from the reaction zone and wherein the one or more gas-impermeable membranes transport the ionic species;

introducing the ion source gas from which the ionic species is formed into the reagent zone of the reactor;

introducing a gas into which the ionic species is to be transported and released into the reaction zone of the reactor; and

heating the one or more gas-impermeable membranes of the reactor to a temperature such that the ionic species is formed and transported through the one or more gas-impermeable membranes and released into the gas in the reactant zone.

51. (new) The method of claim 50 wherein the ionic species is carbonate.

52. (new) The method of claim 51 wherein the ion source gas is air.

53. (new) The method of claim 50 wherein the ionic species is a reactive ion, wherein the gas introduced into the reaction zone is a reactant gas which undergoes reaction with the reactive ion after the reactive ion is transported through the one or more gas-impermeable membranes, and wherein a product is generated by reaction of the reactive ion with the reactive ion.

54. (new) The method of claim 53 wherein the reactive ion is a reactive cation.

55. (new) The method of claim 53 wherein the reactive ion is a reactive anion.

56. (new) The method of claim 55 wherein the reactive anion is carbonate.

57. (new) The method of claim 56 wherein the ion source gas is air.

58. (new) The method of claim 55 wherein the reactant gas comprises a volatile hydrocarbon.

59. (new) The method of claim 55 wherein the reactant gas comprises methane.

60. (new) The method of claim 53 wherein the ion source gas generates carbonate ions, wherein the reactant gas comprises a volatile hydrocarbon and wherein the product generated is synthesis gas.

61. (new) The method of claim 60 wherein the ion source gas is air.

62. (new) The method of claim 61 wherein the reactant gas is natural gas.

63. (new) The method of claim 55 wherein the reactant gas is a reduced gas that is partially oxidized by reaction with the carbonate ion.

64. (new) The method of claim 63 wherein the reactant gas comprises a hydrocarbon.

65. (new) The method of claim 63 wherein the reactant gas comprises an alkene, an alkyne or an aromatic compound.

66. (new) The method of claim 63 wherein the reactant gas is an epoxide, an aldehyde, a ketone, an alcohol or an amine or mixture thereof.

67. (new) The method of claim 53 wherein the reactive ion is a reactive anion, wherein the reagent zone is a reduction zone, wherein the first outside surface of the one or more gas-impermeable membranes is a reduction surface, wherien the second outside surface of the one or more gas-impermeable membranes is an oxidation surface, wherein the reaction zone is an oxidation zone, wherein the reactive anion is formed at the reduction surface of the one or more gas-impermeable membranes, and is transported through the one or more gas-impermeable membranes to the oxidation surface of the one or more gas-impermeable membranes, and wherein the gas introudcued into the oxidation zone is a reduced gas which undergoes reaction with the reactive anion at the oxidation surface of the membrane to generate a product.

68. (new) The method of claim 67 wherein the reactor further comprises an oxidation catalyst in the oxidation zone of the reactor.

69. (new) The method of claim 68 wherein the oxidation catalyst is provided as an adherent layer on the oxidation surface of the one or more gas-impermeable membranes.

70. (new) The method of claim 68 wherein the oxidation catalyst is provided as a three-dimensional catalyst in close proximity to the oxidation surface.

71. (new) The method of claim 67 wherein the ion source gas generates carbonate ions, heating the one or more gas-impermeable membranes generates carbonate ions at the reduction surface of the one or more gas-impermeable membranes and transports carbonate ions through the gas-impermeable membrane to the oxidation surface of the one or more gas-impermeable membranes; and the reduced gas comprises methane or another volatile hydrocarbon which reacts with carbonate ion to produce synthesis gas.

72. (new) The method of claim 71 wherein the ion source gas is a gas containing carbon dioxide and oxygen.

73. (new) The method of claim 72 whererin the ion source gas is air.

74. (new) The method of claim 71 wherein the reduced gas is natural gas.

75. (new) The method of claim 71 wherein the reactant gas further comprises steam and a steam reforming catalyst is provided as an adherent layer on the oxidation surface of the one or more gas-impermeable membranes or as a three-dimensional catalyst in close proximity to the oxidation surface of the one or more gas-impermeable membranes such that reaction proceeds at least in part by steam reforming.

76. (new) The method of claim 67 wherein the reactive ion is carbonate ion and wherien the reduced gas which is partially oxidized by reaction with carbonate ion at the oxidation surface of the one or more gas-impermeable membranes.

77. (new) The method of claim 76 wherein the reactor further comprises an oxidation catalyst in the oxidation zone of the reactor.

78. (new) The method of claim 76 wherein the reduced gas comprises a hydrocarbon.

79. (new) The method of claim 76 wherein the reduced gas comprises an alkene, an alkyne or an aromatic compound.

80. (new) The method of claim 76 wherein the reduced gas is an epoxide, an aldehyde, a ketone, an alcohol or an amine or mixture thereof.

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